SOLITARY ABSCESS OF THE LIVER.

A CONTRIBUTION TO THE PATHOLOGY, DIAGNOSIS, AND TREATMENT OF THIS DISEASE, BASED ON THE STUDY OF EIGHTEEN CASES.

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DURING the last decade the literature on abscess of the liver has grown to very large proportions. Especial attention has been paid to the so-called tropical abscess, and the symptoms and treatment of this affection have been carefully studied. There has been considerable confusion, however, in the meaning of the term "tropical abscess." Some writers have called every single abscess a tropical one, while others have limited the term to solitary abscesses which occurred in the tropics. It would be preferable, I think, to limit the term "tropical abscess" to those cases which occur in individuals who have lived or are living in the tropics and in whom there is a preceding history of amebic dysentery, although it might be allowable to include under the same head amebic abscesses of the liver which occurred in the temperate zones.

The term "tropical abscess" is also frequently used to distinguish the solitary from the multiple abscesses of the liver. This is not strictly correct, because not a small number of amebic abscesses are multiple. It is more correct to speak of single or solitary and of multiple abscesses of the liver, and to include under each of these heads the different varieties of abscesses classed according to their etiology. Under the head of single or solitary abscess of the liver would therefore be grouped the following:

1. The tropical abscess, following tropical dysentery.

This is associated with the presence of the ameba coli, and is said to follow rarely dysentery due to Shiga's bacillus (dysenteric abscess of Kartulis[32]).

2. The traumatic abscess, either as a secondary infection of a hæmorrhage into the liver substance, or by direct infection from the surface of the body.

3. The pyæmic abscess, as a part of a systemic pyæmia. With this is not necessarily associated a bacteriemia (Libman).

4. Liver abscess secondary to a variety of abdominal affections. In this form the connection between the abscess and the primary disease is often in doubt. The infection is probably carried to the liver by the portal vein (idiopathic abscess of Kartulis).

During the last five years, 18 patients with solitary liver abscess were operated upon in the Second Surgical Service at Mt. Sinai Hospital.* In the majority of the patients the source of the infection could not be determined with certainty, although in a number of them there was a history of some preceding disease. These cases form the basis of the present paper.†

In 12 of the 18 patients there was a history of a preceding disease, viz.:

Trauma (gunshot wound) in one patient.
Cholelithiasis in one patient.
Chronic colitis in one patient.
Acute appendicitis in one patient.
Osteomyelitis of tibia in one patient.
Hemorrhoids in two patients.
Intermittent fever in two patients.
Occasional diarrhœa in three patients.

In the six other patients there had been no previous illness.

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* Eight cases were operated upon by Dr. Lilienthal, four by Dr. J. Wiener, six by Dr. Elsberg.

† Two cases of suppurating gumma of the liver and one of suppurating echinococcus cyst are not included. Six cases of multiple abscesses of the liver are referred to later.

The history of the patient who had a solitary abscess of the liver after an attack of acute appendicitis follows:

Jacob E., 40 years of age, was admitted to the hospital on July 23, 1902. He had been operated on for an inguinal hernia six weeks before and for acute appendicitis three weeks before at another hospital. Very little of the history of the present illness could be obtained from the patient. He declared that for two weeks he had had chills and fever, with pain in the right hypochondrium.

Condition on admission, markedly emaciated. Examination of the chest reveals the following: In front there is dulness at the second right intercostal space, flatness from the fourth interspace to the base of the lung, with absence of voice and breathing. Posteriorly, there is flatness on percussion from the angle of the scapula to the base of the lung, with absent voice and breathing below the fifth interspace. Lower intercostal spaces on the right side very tender; area of marked tenderness below angle of scapula. Abdomen: unhealed wound in the right iliac region from which there is a moderate purulent discharge; percussion shows the liver to be enlarged upwards and downwards, lower border two finger-breadths below free costal margin; abdomen rigid, distended and tympanitic. Aspiration in ninth space post-axillary line gave thick non-odorous pus.

July 23, under ether anæsthesia, three inches of the ninth rib were resected (Dr. Elsberg), the pleural cavity, which contained clear serum, was opened and walled off with gauze as no sutures would hold, the diaphragm incised, and 54 ounces of pus evacuated. The subphrenic abscess was found to communicate with a large cavity in the right lobe of the liver; drainage.

Convalescence was uneventful; the temperature, which had been high, soon fell to the normal, and the patient was discharged cured twenty-four days after the operation.

Cultures made from the pus remained sterile; no amebæ could be found in the discharge from the wound.

While subphrenic abscesses and multiple abscesses of the liver are not so very rare after acute appendicitis (subphrenic abscess occurs in 2½ per cent. of the patients (Elsberg[1]):

multiple abscesses of the liver in 0.8 per cent. (Gerster[2]), solitary abscesses are very infrequent. Thus I have been able to find only 14 cases in medical literature although there have no doubt been a larger number (Cases of Herczel,[3] Chvostek,[4] Munro,[5] Sheen,[6] Koerte[7] (2), Delageniere,[8] Loison,[9] Jones,[10] Norton,[11] Sonnenburg,[12] Hildebrandt,[13] Shoemaker,[14] Besancon[15]). The patient of Delard,[16] often referred to, probably had only a subphrenic abscess, and one of Koerte's[7] patients had multiple abscesses.

Infection may reach the liver from the appendix or from another part of the abdominal cavity in one of several ways: (1) By direct extension, either through the bile-ducts or from abscesses in close proximity to the liver (subphrenic, perinephritic); (2) by the lymphatics; (3) through the arteries, as part of a systemic infection; (4) through the portal vein.

Koerte[17] and Loison[18] believe that hepatic suppuration often results from the direct extension of the suppurative process from the appendix region through the retroperitoneal cellular tissue. To judge from the cases of liver abscess reported in literature, this is not as frequent as these writers would lead us to believe. Loison states, in support of his view, that where there is a subphrenic abscess with a liver abscess it is impossible to say whether the liver abscess perforated the capsule of Glisson and became perihepatitic or whether the latter perforated the capsule of the liver and caused the hepatic abscess. Munro voices his belief that a considerable number of liver abscesses are due to extension to the perihepatic region through the lymphatics, while on the other hand Jones[10] denies that there are any lymphatics that run directly to the liver. The opinion of most writers seems to be that while infection of the liver through the lymphatics and from the perihepatic regions is possible, it is not of frequent occurrence.

In the majority of cases solitary abscess of the liver after appendicitis is due to bacteria or their products that are carried to the organ through the portal vein. Loison has pointed out that the organisms may travel up the vein and set up the liver suppuration without leaving behind demonstrable changes in the vessel or its large branches.

Whether the abscess be a single one or multiple will depend not only upon the number of organisms that are carried to the liver, and their virulence, but also upon whether the infectious material is diffused over a very small area of liver substance in one lobe, or is spread over the greater part of one or of both lobes of the liver. In a certain number of cases the single abscess may be due to the confluence of several small abscesses in a lobule of the organ. Clark,[20] Windsor,[21] Loison and others have shown that the solitary tropical abscess is often due to the merging of numerous smaller abscesses. Hence if the organisms that have entered the portal vein are carried to one or a few of the terminal branches of the vein, the abscess may be a solitary one, but if the septic matter is carried into a large number of branches multiple abscesses will ensue.

It is perfectly possible for a lesion in the gastro-intestinal tract which gave no symptoms to contribute sufficient infectious matter to cause in this way a single abscess of the liver. I believe that this is the explanation for many if not most of the single abscesses of the liver that are seen in the temperate zones, whose etiology has not been determined.

Location of the Abscess.—In 16 of our 18 cases, the abscess was located in the right lobe, and with one exception in the upper part of the right lobe. According to Rolleston,[22] 80 per cent. are in this situation, while Jones states that only 6 per cent. occur in the left lobe. The more frequent affection of the right lobe is due to the fact that the branch of the portal vein that supplies the right lobe of the liver is larger, shorter, and more direct than the left branch.

The size of the abscess and the amount of pus it contains vary within wide limits, the largest quantities being found in the cases in which the abscess has secondarily invaded the subphrenic space.

The contents of the abscesses were of a yellow, brownish red or green color, and usually thick and of a mucoid consistency. In four of our cases the pus had a foul odor,—three were cases with subphrenic abscess, and in the fourth case the odor was probably due to the presence of anerobic bacteria.

Our records are unfortunately incomplete as regards the organisms found in the pus, as no cultures were taken in some of the early cases. Of the ten cases in which examinations were made, the pus was sterile in six (60 per cent.), which corresponds pretty closely to the results of Giordano[23] who examined 72 cases and found the pus sterile in 58.4 per cent. The staphylococcus citreus was present once, streptococcus once, bac. coli once, anerobes once. A careful search for the amebæ coli was made in all of the cases but they were found only once.

The hepatic abscess had burst into the subphrenic region in six of the eighteen patients (30 per cent.). The pleural cavity contained clear serum in four patients, it was normal in three, it could not be examined in ten. Perforation of the diaphragm did not occur a single time.

Symptomatology.—The symptoms of solitary abscess of the liver may come on days, weeks or months after the primary disease. After having been well marked they may disappear for a time, the dormant stage of liver abscess. Several modes of onset are, however, characteristic.

I. *Acute Onset.*—(*a*) With or without a history of previous illness, the patient is suddenly attacked with pain in the lower part of the right or left chest, chills, fever, sweating, a dry cough, and marked prostration. The chills or chilly sensations are repeated daily, the pain persists, there is very rapid emaciation, the liver becomes enlarged and tender. (*b*) The patient is suddenly attacked with pain in the epigastrium and right or left hypochondrium, fever, cough, prostration. These symptoms increase in severity, and tenderness and muscular rigidity in the upper part of the abdomen soon appear. The liver becomes enlarged and tender, and the patient presents the picture of an acute abdominal infection. The abdominal type of onset.

II. *Subacute or Chronic Mode of Onset.*—(*a*) Without any previous disease or a number of years after some illness, the patients begin to have a dry cough, complain of a heavy feeling or slight pain in the lower part of the right or left chest, and begin to lose flesh and strength. After weeks or months, during part of which time the symptoms may be in abeyance, the temperature begins to rise and soon becomes of an intermittent type, chills or chilly sensations with sweats occur, and the liver becomes enlarged and tender; or (*b*) The mode of onset is similar to that of subphrenic abscess. The patients have an irregular fever as the first symptom, and then lose flesh and strength rapidly. These patients may show no local signs of their disease until the abscess invades the subphrenic region. Without any change in the temperature, respiration or pulse, some patients complain of continual slight pain in the right or left chest. The pain persists for weeks or months. Physical examination of the chest results negatively, and the patients never look very ill. Sooner or later the pain in the chest becomes more severe, there is enlargement of the liver, dulness, perihepatitis, and signs of fluid in the pleural cavity of the affected side. Then the presence of fluid under the diaphragm and perhaps in the pleural cavity is found by physical examination and the aspirating needle.

A detailed account of the various symptoms and signs that may be present in this affection would occupy too much space. Mention will only be made of some of the more important ones:

Pain, fever, enlargement of the liver, and emaciation are the characteristic symptoms of abscess of the liver, although one or more of these may be absent.

Acute pain may be absent entirely or may only appear late in the disease. It is not apt to occur as early as in subphrenic abscess, and is due in most cases to the perihepatitis which follows when the suppuration nears the surface of the liver. The pain is usually referred to the region of the liver and more especially to the lower part of the right or left chest in front. The patients most often complain of pain along the free costal border or within an area situated between the mammary and posterior axillary lines. These localized areas of pain usually correspond to the points of greatest tenderness on pressure (Smits,[24] Koerte, Godlee,[25] etc.).

The tenderness along the free border of the ribs is usually most marked in the mammary line, but with marked abdominal rigidity it may be impossible to localize the point of maximum tenderness in this region. The other area of tenderness is obtained by pressure in the intercostal spaces between the eighth and the eleventh ribs on the right side, or below the ninth rib on the left side, somewhere between the anterior axillary and the scapular lines. Increase of the tenderness in this or in the infracostal region usually means that the abscess is approaching the upper or lower border of the liver or both. In some cases (two of our series) there was bulging in some of the lower intercostal spaces.

Pain in the shoulder was present in only four of the eighteen patients. Some writers, if not most of them, lay great stress on this symptom. Kramm[26] declares that it was present in 50 per cent. of his cases (tropical abscess), while it was said to have been almost the only symptom in a patient of Bramwell and Stiles.[27] On the other hand, pain in the shoulder was mentioned only twice in the 28 cases reported by Hart.[28]

Enlargement of the liver may be absent if the abscess be a very small one, but there is usually more or less increase in the size of the organ. The liver was enlarged in all but one of our cases. It was enlarged both upwards and downwards, although it was sometimes difficult to map out the upper border of the organ with certainty in the presence of a subphrenic abscess or of fluid in the pleural cavity. The lower border of the liver was enlarged downwards in 17 of the 18 cases, and in all but two of these it was plainly palpable. Perthes,[29] speaking of the tropical abscess, says that even with an abscess of considerable size in the right lobe there may be no enlargement downwards, while Kiefer,[30] from his large experience, declares that enlargement downwards is not the rule. The only explanation that I can offer for the difference between the abscesses we have observed and those described by the above-mentioned writers, is that in tropical abscess enlargement of the liver is not as frequent as in the abscesses here reported. The upper level of liver dulness is usually a curve, with its convexity upwards, which does not change with change in the patient's position. This convexity is, however, wanting when there is fluid in the pleural cavity.

Fever was present in every one of our cases. It usually ran an irregularly intermittent course, and in 9 of the 18 cases was accompanied by chills or chilly sensations and sweats.

A marked and rapid loss of flesh and strength was one of the chief complaints in 11 out of 16 patients. It was not unusual for the patients to have lost from ten to twenty pounds in one or two weeks.

Cough without or with slight expectoration was noted in 6 of the 18 patients (30 per cent.).

Jaundice occurred only twice among the patients, although most of the patients had a characteristic sallow, yellowish color. In this connection it might be mentioned that excepting in the two patients with jaundice above mentioned, we have never been able to find bile in the urine. Wendel,[31] however, declares that he always found bile pigments in the urine in tropical abscess.

In every one of our cases in which a white blood-count was made, there was a leucocytosis—the smallest number of white cells in the cm. was 8100, and the largest, 34,500.

Diagnosis.—The greatest difficulties in diagnosis are encountered in the effort to differentiate between a single abscess and multiple abscesses, between liver and subphrenic abscess, or liver with subphrenic abscess. In many cases the differential diagnosis is impossible before the operation; a pleurisy with effusion or empyema and a subphrenic abscess may be recognized, while the underlying cause of the condition—the hepatic abscess—remains unrecognized. The first point to determine is whether the affection is above or below the diaphragm or whether there is disease in both these regions—in other words, is there a pleural effusion alone, or a subphrenic or liver affection alone, or are both combined? The physical signs of pleurisy with effusion and of empyema need not be described here; mention will be made of only a few signs that are of diagnostic value. With a beginning pleural effusion there are more apt to be symptoms which point to an affection of the chest,—rapid respiration, cough, expectoration; the level of the dulness is generally concave upward, and the upper border of the dulness changes distinctly with a change in the position of the patient.

When there is a well-marked effusion under the diaphragm there are usually few or no thoracic symptoms; the upper level of the dulness is a straight line, or is convex upward, there is little change in the line of dulness with a change in the position of the patient. In pleural effusions the respiratory murmur is much diminished or absent below the level of the fluid, while in subphrenic or hepatic abscesses the murmur can generally be plainly heard below the level of the fluid. The heart is never appreciably pushed to the right. The greatest difficulties in diagnosis are met with in the cases in which a pleurisy with effusion is associated with a collection of pus underneath the diaphragm in the liver or in the subphrenic region. When the subphrenic abscess contains gas, the diagnosis of the two associated conditions is possible. In the upper part of the chest there are then the signs of pleuritic effusion, and below these the signs of an effusion containing gas. When the quantity of fluid in the pleural cavity is considerable, it may be impossible to make the diagnosis of a primary subphrenic abscess, or subphrenic secondary to liver abscess, or of primary liver abscess, except from a careful study of the patient's history and by means of the aspirating needle. If pus is withdrawn by aspiration through one of the lower intercostal spaces and clear fluid by aspiration higher up, the diagnosis of an association of two conditions is almost assured.

We have not found Litten's diaphragm phenomenon of much diagnostic significance, for it can be found to be present in many normal individuals.

According to Fuerbringer,[32] the motions of an aspirating needle introduced into the abscess are pathognomonic. Fuerbringer claimed that during inspiration and expiration an exploring needle which had been introduced to below the diaphragm would move in the opposite direction to what it would do if it were in the pleural cavity. The movements of the diaphragm are often greatly impaired, especially when the diaphragmatic is adherent to the costal pleura and the costophrenic sinus obliterated. We have found this sign, however, of considerable value when it was present.

Localized œdema of the chest-wall, if present, is of importance, since it shows that the abscess is approaching the surface of the body.

The differential diagnosis between subphrenic abscess and abscess of the liver is very difficult and often impossible. In both affections the liver dulness is increased upwards and downwards and limited above by the diaphragm; in both is the lowermost level at which the respiratory sounds can be heard below the level of dulness; the clinical symptoms of hepatic abscess may be in all respects like those of subphrenic disease, or the latter is present secondary to a liver abscess.

As I have already shown, solitary abscess of the liver after appendicitis is rare as compared with subphrenic or multiple hepatic abscesses. Accompanying disease of the pleura (serous, sero-purulent or purulent effusion) is more rare in hepatic abscesses than in those in the subdiaphragmatic region. (The pleura were the seat of secondary inflammation in about 50 per cent. of the cases of subphrenic abscess collected by the writer.) For a number of other facts of diagnostic value for the differentiation between subphrenic and liver abscess the reader is referred to a paper on subphrenic abscess published a few years ago (ANNALS, December, 1901).

The differential diagnosis between solitary and multiple abscesses of the liver is impossible in many if not most of the cases, although sometimes a careful consideration of the etiology and the course of the disease may result in the making of a correct diagnosis. Appendicular disease and affections of the gall-bladder and bile-ducts are more apt to be followed by multiple hepatic abscesses. The presence of fluctuation in the intercostal spaces or in the hypochondrium points rather to solitary abscess. Enlargement of the spleen occurs more often in multiple abscesses. Multiple abscesses of the liver are very apt to give marked symptoms early when the suppurating areas are still small, so that in a case where all of the symptoms and signs pointed to suppuration in the liver, negative results of repeated aspirations should make one think of the greater probability of multiple abscesses. Although there may be a well-founded suspicion that there are numerous abscesses, the patient should always (if the general condition permits it) be given the benefit of the doubt and operative interference be instituted as soon as pus has been found by the aspirating needle. Although, in a very few cases, a cure has followed the drainage of a number of abscesses of the liver, the presence of multiple abscesses is usually a fatal complication.* The danger from repeated aspirations of the liver, however, is not very great if one is prepared to follow at once with the operative interference.

There are several other conditions with which abscess of the liver may be confused, and which must be mentioned here. The differentiation of simple abscess from suppurating echinococcus cyst may be impossible until pus has been found with the aspirating needle and the characteristic hooklets have been found in it by the microscope. A previous history of liver tumor which has existed for many years before the onset of the present symptoms, may be of diagnostic value.

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* In the cases of this kind, there were usually two or three large abscesses which were successively opened and drained. There is to the best of my knowledge not a single case on record where recovery has resulted in the presence of innumerable large and small abscesses scattered over both hepatic lobes, as are found in most cases of multiple abscesses of the liver.

Metastatic carcinoma of the liver may cause enlargement and tenderness of the organ and is often accompanied by an irregular intermittent fever. During the past year there have been two patients on the Second Surgical Service at Mt. Sinai Hospital with metastatic carcinoma of the liver,—secondary to malignant disease of the rectum in the one case, and of the breast in the other. Both patients had enlarged and tender livers and for a number of weeks an irregular fever of between 100° and 104°. A history of preceding malignant disease in some other part of the body, or its demonstrable presence, a hard palpable tumor of the liver, cachexia, and the absence of a marked increase of polynuclear leucocytes in the blood, are of diagnostic value. The differential diagnosis can usually be made without recourse to the aspirating needle. The diagnosis of gumma can usually be made from the history. Other conditions that may have to be differentiated from abscess of the liver are malarial fever, intermittent hepatic fever due to infective cholangitis, abscess of the spleen (when the hepatic abscess is in the left lobe) and, rarely, large abscess of the kidney.

Prognosis.—The mortality after operations for solitary abscess of the liver is not as large as one would expect in view of the serious nature of the disease and the importance of the organ affected. Of the eighteen patients in our series five died (28 per cent.). Kieffer[33] believes that if the patients come to fairly early operation, 90 per cent. should recover.

Most operators have a mortality of between 20 per cent. and 50 per cent., although Smits[34] saved 18 out of 21 patients by early operation. Of 182 cases collected by Perutz[35] 44 died, a mortality of 24 per cent. From the cases we have seen we have gained the impression that the prognosis of amebic abscess of the liver occurring in temperate zones is not as good as the prognosis in single abscess associated with the presence of other organisms.

Treatment.—Whenever, after an acute abdominal affection, in which the local symptoms have been relieved, there are chills, intermittent fever, and rapid emaciation, it is important to examine the liver very carefully from day to day and to keep the possibility of a suppurative process in that organ in mind. As soon as the signs justify aspiration of the liver, *this should be done, and when pus has been discovered, there* should be no delay before operation is done. In rare cases, the symptoms and signs of liver suppuration may be so clear, and the rapid deterioration of the patient's condition so evident, that even when repeated aspirations have resulted negatively, an exploratory operation is justifiable. The following case of this nature is of sufficient interest to be reported in detail in this place:

Rebecca R., 32 years of age, was admitted to the Second Surgical Service of Mt. Sinai Hospital, on July 5, 1904. Twelve hours before, the patient had received a bullet-wound in the upper part of the right chest. It had been supposed by the physician who saw her at the time that the wound was only a superficial one. As her general condition was becoming steadily worse, she was brought to the hospital.

On admission, she was almost in collapse; the pulse was very small and rapid; the tongue dry and coated; just above the right breast in the fourth intercostal space was a small punctured wound with a large area of ecchymosis around it. The abdomen was generally distended and tympanitic; everywhere tender and rigid, but the rigidity and tenderness most marked in the epigastric and left hypochondriac regions. There was a normal area of liver dulness, but there was some movable dulness in the left flank.

The patient complained of severe cramp-like pain in the upper part of the abdomen but she could not localize it on one or the other side.

On the suspicion of an abdominal injury, she was at once taken to the operating-room for operation (Dr. Elsberg). Under ether anæsthesia the point of entrance was first carefully probed. The probe passed downwards and to the left to the lower part of the sternum, where the bone was found to be bare. An incision was made at this point, and it was then found that the bullet must have passed downward into the abdominal cavity.

The abdomen was then opened by a median incision above the umbilicus. When the peritoneum was incised, a large quantity of dark blood escaped, together with a little gas. On the under-surface of the left lobe of the liver was a large irregular lacerated *wound from which there was a continual oozing of dark blood.* The wound was packed with gauze, and opposite it on the anterior wall of the stomach was a perforation of that organ about one cm. in diameter from which fluid stomach-content was escaping. The perforation was closed by a double layer of Lembert sutures. The lesser peritoneal sac was then opened by an incision along the greater curvature of the stomach. The lesser sac was clean, nor did careful examination of the posterior wall of the stomach reveal a wound in its wall. There was a large collection of blood around the lower part of the kidney.

The patient was, at this stage, in such poor condition, that further interference was considered contraindicated; the liver wound, the suture line on the anterior wall of the stomach and the region of the left kidney were drained with gauze, the abdominal cavity carefully sponged clean, and the greater part of the abdominal wound closed by layer sutures. The wounds in the chest-wall were drained. The patient was removed to her bed with a pulse of 180, but she improved rapidly under energetic stimulation.

From this time up to July 23 the patient steadily improved; the temperatures varied between normal and 101°, the pulse between 100 and 120. The wounds healed up slowly, with but little discharge.

July 23.—Severe chill followed by temperature of 104° and pulse of 140; few friction sounds over left base behind; leucocytes 17,000.

July 24.—Dulness from spine of scapula to base of left lung behind, with bronchial breathing, and almost absent voice and fremitus; aspiration of left chest negative.

July 26.—Rapid pulse has persisted with intermittent high temperatures; almost daily chills; physical signs over lower part of left chest the same as when last noted except that dulness now extends to middle of scapula behind; clear fluid, withdrawn from left of chest with aspirating needle, was sterile on culture.

August 4.—The patient's condition has grown steadily worse, high temperatures and rapid pulse persist; the signs over the lower part of the left chest the same as when last noted; the patient is much emaciated; there are irregular chills with sweats; leucocytes 23,800. The left lobe of the liver is slightly enlarged downwards and is tender. The left lobe of the liver was aspirated almost daily but no pus could be found. X-ray showed the bullet between the ninth and tenth ribs behind, probably in the left subphrenic region.

August 6.—In spite of active stimulation, the patient is very weak to-day; she had a severe chill this morning, after which the pulse was almost imperceptible for several hours. The left lobe of the liver and left subphrenic region were aspirated in all directions, but the results were negative.

As the patient seemed almost moribund, and because of the probability of suppuration around the region of the bullet, it was determined to do an exploratory operation as a last resort. Under a light chloroform anæsthesia, three inches of the ninth rib on the left side were resected, the diaphragm exposed by pushing up the reflexion of the pleura, and the left lobe of the liver aspirated; the first aspiration withdrew thick grey pus. The diaphragm was then incised and the liver again aspirated. This time yellow pus was obtained. With the needle as a director the abscess of the liver was opened with a grooved director and dressing forceps and about two ounces of yellow pus evacuated. On account of the different character of the pus obtained at the first aspiration, the left subphrenic region was again aspirated, thick grey pus obtained, and a small subphrenic abscess opened and drained. By this time the patient was in very poor condition, so that no search could be made for the bullet. The abscesses were drained and the patient put upon energetic stimulation.

On the following day the patient's condition was much improved and the improvement thereafter was a slow but continued one. The temperature and pulse reached the normal after one week; she began to gain flesh and strength rapidly. Thirteen days after the operation the bullet was felt with a probe introduced into the sinus leading into the left subphrenic region, and after some difficulty was removed. It was of 38 calibre.

December 16.—The patient has gained 40 pounds in weight, all wounds are healed and on this day she was discharged from the hospital cured.

Cultures from the pus withdrawn from the abscess of the liver contained the streptococcus.

Remarks.—The interesting feature of this case, aside from the severe nature of the injuries and the recovery of the patient, was the fact that repeated aspirations were never able to find the pus in the left lobe of the liver and the left subphrenic region, although the physical signs, the presence of fluid in the left chest, and the probable location of the bullet by the X-ray in the left subphrenic region, pointed to an abscess in that location.

The exposure of a lobe of the liver and the adjoining subphrenic region can be made by one of two routes,—either by transpleural or infrapleural thoracotomy, or by an abdominal incision through the right or left rectus muscle. The abdominal operation must be retained only for those cases in which the symptoms and signs point to an abscess approaching the under surface of the right or left lobe of the liver, and in those in which there are mainly abdominal symptoms.

In the large majority of the cases, however, the abscess is located in the upper part of the liver and had best be approached through the wall of the chest. The technique of infrapleural or transpleural thoracotomy will not be described here, as the writer has described the typical operation in detail in a paper on subphrenic abscess (ANNALS OF SURGERY, December, 1901). I desire, however, to again lay stress upon one point in the technique of the transpleural operation which seems to me of great value, but which as yet has not been given the prominence it deserves.

In the transpleural operation (if the costo-phrenic sinus has not become obliterated by adhesions) the suture of the diaphragmatic to the costal pleura after the incision of the latter can often not be accomplished without the entrance of more or less of air into the pleural cavity. By means of upward pressure against the liver, however, it is usually possible to so closely approximate the diaphragmatic to the costal pleura that little or no air can enter the pleural cavity when the pleura is incised and while the two layers of the pleura are being united by suture. The writer has found this method of great value in preventing an acute pneumothorax where there are no adhesions.

When the diaphragm has been incised, and there are no adhesions between it and the liver, the peritoneal cavity must be carefully walled off on all sides by gauze packings (which must be allowed to remain undisturbed for six to ten days after the operation). The liver is then aspirated and when the pus has been located, a grooved director is pushed into the abscess along the needle, the canal dilated with dressing forceps, and the abscess drained according to general surgical principles. If the abscess is deeply situated in the lobe of the liver, it may be advisable to use the actual cautery on account of the danger of hæmorrhage. In most instances the careful dilatation with the dressing forceps is all that is required.

When the abscess has burst into the subphrenic region, all that is necessary is to drain the subphrenic space after having made sure by digital exploration that the opening into the liver abscess is large enough to allow of free drainage. The liver has often to be drained separately with a large tube.

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